CLAIMS

00207.RE2 270901

1. A piston-chamber combination comprising an elongate chamber (1,21,60,70,90,169,216, 231) which is bounded by an inner chamber wall (2,3,4,5,61,62,63,64,65,71,73,75,91, 155,156,157,158) and comprising a piston (20,20',36,36',49,49',50,50',59,59'76,76',92, 92',118,118',138,138',146,146',163,168,168',189,189',208,208',222,222',222')in said chamber to be sealingly movable relative to said chamber at least between first and second longitudinal positions of said chamber,
said chamber having cross-sections of different cross-sectional areas at the first and second longitudinal positions of said chamber and at least substantially continuously different cross-sectional areas at intermediate longitudinal positions between the first and second longitudinal positions thereof, the cross-sectional area at the first longitudinal position being larger than the cross-sectional area at the second longitudinal position,
said piston including a piston body and sealing means supported by the piston body (8,8',25, 25',41,41',53,83,102,102',112,117,129,129',167,167',182,198,198',220,220')for sealing on said inner chamber wall, the piston body being designed to adapt itself and said sealing means to said different cross-sectional areas of said chamber during the relative movements of said piston from the first longitudinal position through said intermediate longitudinal positions to the second longitudinal position of said chamber.

2. A combination according to claim 1, wherein the cross-sectional area of said chamber at the second longitudinal position thereof is between 95% and 15% of the cross-sectional area of said chamber at the first longitudinal position thereof.

3. A combination according to claim 1, wherein the cross-sectional area of said chamber at the second longitudinal position thereof is 95-70% of the cross-sectional area of said chamber at the first longitudinal position thereof.

4. A combination according to claim 1, wherein the cross-sectional area of said chamber at the second longitudinal position thereof is approximately 50% of the cross-sectional area of said chamber at the first longitudinal position thereof.

5. A combination according to any of the preceeding claims, wherein the piston (20,20',

36,36',49,49',76,76',118,118',163,189,189') comprises:

- a plurality of at least substantially stiff support members (10,28,43,43',81,82, 184) rotatably fastened to a common member (6,23,45,180),
- elastically deformable means (8,8',25,25',41,41',79), supported by said supporting members, for sealing against the inner wall (2,3,4,5,71,73,75,155,156,157, 158) of the chamber (1,21,60,70) said support members being rotatable between 10° and 40° relative to the longitudinal axis (19) of the chamber (1,21,60,70).

6. A combination according to claim 5, wherein the support members (10,28,43, 43',81,82,184) are rotatable so as to be at least approximately parallel to the longitudinal axis (19).

7. A combination according to claim 5, wherein the common member (6,23,45,180) is attached to a handle for use by an operator, and wherein the support members (10,28,43, 43',81,82,184) extend, in the chamber (1,21,60,70), in a direction relatively away from said handle.

8. A combination according to claim 5 or 7, further comprising means (9,9',31,46,46',79, 183) for biasing the support members (10,28,43,43',81,82,184) against the inner wall (2, 3,4,5,71,73,75,155,156,157,158) of the chamber (1,21,60,70).

9. A combination according to any of claims 1 to 4, wherein the piston (92,92',146,146',-168,168',208,208',222,222',222'') comprises an elastically deformable container comprising a deformable material (103,103',124,124',136,137,173,173',174,174',205,205',206,206'215, 215',219,219').

10. A combination according to claim 9, wherein the deformable material (103,103',124, 124',136,137,173,173',174,174',205,205',206,206'215,215',219,219') is a fluid or a mixture of fluids, such as water, steam and/or gas, or a foam.

11. A combination according to claim 9 or 10, wherein, in a cross-section through the longitudinal direction, the container, when being positioned at the first longitudinal position of the chamber (90,169,216,231), has a first shape which is different from a second shape of

the container when being positioned at the second longitudinal position of said chamber.

12. A combination according to claim 11, wherein at least part of the deformable material (103,103',137,173,173',206,206',215,215') is compressible and wherein the first shape has an area being larger than an area of the second shape.

13. A combination according to claim 11, wherein the deformable material (124,124', 136,174,174',205,205',219,219') is at least substantially incompressible.

14. A combination according to claim 9 or 10, wherein the container is inflatable.

15. A combination according to any of claims 9 to 14, wherein the piston (146, 146',208,208',222,222',222'') comprises an enclosed space (125) communicating with the deformable container, the enclosed space (125) having a variable volume.

16. A combination according to claim 15, wherein the volume is manually adjustable.

17. A combination according to claim 15, wherein the enclosed space (125) comprises a spring-biased pressure tuning piston (126,138,138',149,149').

18. A combination according to any of claims 15 to 17, further comprising means (148, 148',149,149',217,218) for defining the volume of the enclosed space (125) so that the pressure of fluid in the enclosed space (125) chamber relates to the pressure acting on the piston (222,222',222'') when being positioned at the second longitudinal position of the chamber (216).

19. A combination according to claim 18, wherein the defining means (148,148',149, 149',217,218) are adapted to define the pressure in the enclosed space (125) at least substantially identical to the pressure acting on the piston (222,222',222'') when being positioned at the second longitudinal position of the chamber (216).

20. A combination according to any of the preceeding claims, wherein the cross-sections of the different cross-sectional areas have different cross-sectional shapes, the change in cross-

sectional shape of the chamber (162) being at least substantially continuous between the first and second longitudinal positions of the chamber (162), wherein the piston (163) is further designed to adapt itself and the sealing means to the different cross-sectional shapes.

21. A combination according to claim 20, wherein the cross-sectional shape of the chamber (162) at the first longitudinal position thereof is at least substantially circular and wherein the cross-sectional shape of the chamber (162) at the second longitudinal position thereof is elongate, such as oval, having a first dimension being at least 2, such as at least 3, preferably at least 4 times a dimension at an angle to the first dimension.

22. A combination according to claim 20 or 21, wherein the cross-sectional shape of the chamber (162) at the first longitudinal position thereof is at least substantially circular and wherein the cross-sectional shape of the chamber (162) at the second longitudinal position thereof comprises two or more at least substantially elongate, such as lobe-shaped, parts.

23. A combination according to any of claims 20 to 22, wherein a first circumferential lenght of the cross-sectional shape of the cylinder (162) at the first longitudinal position thereof amounts to 80-120%, such as 85-115%, preferably 90-110, such as 95-105, preferably 98-102%, of a second circumferential length of the cross-sectional shape of the chamber (162) at the second longitudinal position thereof.

24. A combination according to claim 23, wherein the first and second circumferential lengths are at least substantially identical.

25. A combination according to any of claims 1 to 4, wherein the piston comprises:

- an elastically deformable material (25,25') being adapted to adapt itself to the different cross-sectional areas of the chamber (21) between the first and second longitudinal positions thereof, and
- a coiled flat spring (31) having a central axis at least substantially along the longitudinal axis (19) of the chamber (21), the spring (31) being positioned adjacently to the elastically deformable material (25,25') so as to support the elastically deformable material (25,25') in the longitudinal direction.

26. A combination according to claim 25, wherein the piston (36,36') further comprises a number of flat supporting means (28) positioned between the elastically deformable material (25,25') and the spring (31), the supporting means (28) being rotatable along an interface between the spring (31) and the elastically deformable material (25,25').

27. A combination according to claim 26, wherein the supporting means (28) are adapted to rotate from a first position to a second position wherein, in the first position, an outer boundary thereof may be comprised within the cross-sectional area of the chamber (21) in the first longitudinal position thereof and wherein, in the second position, an outer boundary thereof may be comprised within the cross-sectional area of the chamber (21) in the second longitudinal position thereof.

28. A combination according to any of claims 9 to 19, wherein the container comprises an elastically deformable material (99,101,131,132,133,170,170',172,190) comprising reinforcement means (100,130,171).

29. A combination according to any of claims 1 to 4, comprising a hose to form the piston (59), the hose, when being positioned at the first longitudinal position of the chamber (60), having substantially the shape of a cone with the larger diameter thereof facing the second longitudinal position of the chamber (60).

30. A combination according to claim 29, wherein the hose comprising reinforcement windings having a braid angle which is different from 54°44'.

31. A combination according to claim 28, wherein the reinforcement means comprises fibres (130,171).

32. A combination according to any of claims 10 to 19 or claim 28 to 31, wherein the foam or fluid is adapted to provide, within the container, a pressure higher than the highest pressure of the surrounding atmosphere during translation of the piston (148,149) from the first longitudinal position of the chamber (216) to the second longitudinal position thereof or vice versa.

33. A piston-chamber combination comprising an elongate chamber (231) bounded by an inner chamber wall and comprising a piston in the chamber to be sealingly movable in the chamber,

- the piston (230) being movable in the chamber (231) at least from a first longitudinal position thereof to a second longitudinal position thereof,
- the chamber (231) comprising an elastically deformable inner wall (238) along at least part of the length of the chamber wall between the first and second longitudinal positions,
- the chamber (231) having, at the first longitudinal position thereof when the piston (230) is positioned at that position, a first cross-sectional area, which is larger than a second cross-sectional area at the second longitudinal position of the chamber (231) when the piston (230) is positioned at that position, the change in cross-sections of the chamber (231) being at least substantially continuous between the first and second longitudinal positions when the piston (230) is moved between the first and second longitudinal positions.

34. A combination according to claim 33, wherein the piston (230) is made of an at least substantially incompressible material.

35. A combination according to claim 33 or 34, wherein the piston (230) has, in a cross section along the longitudinal axis, a shape tapering in a direction from the first longitudinal position of the chamber (231) to the second longitudinal position thereof.

36. A combination according to claim 35, wherein the angle (ξ) between the wall (238) and the central axis (236) of the cylinder (231) is at least smaller than the angle (υ) between the wall of the taper of the piston (230) and the central axis (236) of the chamber (231).

37. A combination according to any of claims 33 to 36, wherein the chamber (231) comprises:

- an outer supporting structure (234) enclosing the inner wall (238) and
- a fluid (232,233) held by a space defined by the outer supporting structure (234) and the inner wall (238).

38. A combination according to claim 37, wherein the space defined by the outer structure

(234) and the inner wall (238) is inflatable.

39. A combination according to claim 33, wherein the piston (222'') comprises an elastically deformable container comprising a deformable material and designed according to claims 11 to 19.

40. A pump for pumping a fluid, the pump comprising:
- a combination according to any of the preceeding claims,
- means for engaging the piston from a position outside the chamber,
- a fluid entrance connected to the chamber and comprising a valve means, and
- a fluid exit connected to the chamber.

41. A pump according to claim 40, wherein the engaging means have an outer position where the piston is at the first longitudinal position of the chamber, and an inner position where the piston is at the second longitudinal position of the chamber.

42. A pump according to claim 40, wherein the engaging means have an outer position where the piston is at the second longitudinal position of the chamber, and an inner position where the piston is at the first longitudinal position of the chamber.

43. A shock absorber comprising:
- a combination according to any of claims 1 to 39,
- means for engaging the piston from a position outside the chamber, wherein the engaging means have an outer position where the piston is at the first longitudinal position of the chamber, and an inner position where the piston is at the second longitudinal position.

44. A shock absorber according to claim 43, further comprising a fluid entrance connected to the chamber and comprising a valve means.

45. A shock absorber according to claim 43 or 44, further comprising a fluid exit connected to the chamber and comprising a valve means.

46. A shock absorber according to any of claims 43 to 45, wherein the chamber and the

piston form an at least substantially sealed cavity comprising a fluid, the fluid being compressed when the piston moves from the first to the second longitudinal positions of the chamber.

47. A shock absorber according to any of claims 43 to 46, further comprising means for biasing the piston toward the first longitudinal position of the chamber.

48. An actuator comprising:

- a combination according to any of claims 1 to 39,
- means for engaging the piston from a position outside the chamber,
- means for introducing fluid into the chamber in order to displace the piston between the first and the second longitudinal positions of the chamber.

49. An actuator according to claim 48, further comprising a fluid entrance connected to the chamber and comprising a valve means.

50. An actuator according to claim 48 or 49, further comprising a fluid exit connected to the chamber and comprising a valve means.

51. An actuator according to any of claims 48 to 50, further comprising means for biasing the piston toward the first or second longitudinal position of the chamber.

52. An actuator according to any of claims 48 to 51, wherein the introducing means comprise means for introducing pressurised fluid into the chamber.

53. An actuator according to any of claims 48 to 51, wherein the introducing means are adapted to introduce a combustible fluid, such as gasoline or diesel, into the chamber, and wherein the actuator further comprises means for combusting the combustible fluid.

54. An actuator according to any of claims 48 to 51, further comprising a crank adapted to translate the translation of the piston into a rotation of the crank.